C-A OPERATIONS PROCEDURES MANUAL

ATTACHMENT

# 9.1.11.c Examples of Beam Flux Corresponding to C-A Class and Dose Rate Guidelines for Beams 20 $CM^2$ in Size

| C-A-OPM Procedures in which this Attachment is used. | | |
|---|---|---|
| 9.1.11 | | |
| | | |
| | | |
| | | |

Hand Processed Changes

| HPC No. | Date | Page Nos. | Initials |
|---|---|---|---|
| _____ | _____ | _____ | _____ |
| _____ | _____ | _____ | _____ |
| _____ | _____ | _____ | _____ |

Approved: _____***Signature on File***_____ _____
Collider-Accelerator Department Chairman Date

J.W. Glenn

## 9.1.11.c Examples of Beam Flux Rate Corresponding to C-A Class and Dose Rate Guidelines for Beams 20 $cm^2$ In Size

| Protons or ions per hour | Dose Equivalent Rate or Absorbed Dose Rate[d] | C-A Class With Access | Brief Description of Access Control |
|---|---|---|---|
| $< 1.2x10^7$ protons[a]<br>$< 7.6x10^5$ O ions[b]<br>$< 3.6x10^5$ Si ions[b]<br>$< 2.2x10^4$ Au ions[c] | < 0.1 rem/h | V | Radiation Warning Signs |
| $> 1.2x10^7$ and $< 5.8x10^8$ p<br>$> 7.6x10^5$ and $< 3.8x10^7$ O<br>$> 3.6x10^5$ and $< 1.8x10^7$ Si<br>$> 2.2x10^4$ and $< 1.1x10^6$ Au | > 0.1 and < 5 rem/h | IV | Barriers, Locked Gates , Authorized Individual Access |
| $> 5.8x10^8$ and $< 5.8x10^9$ p<br>$> 3.8x10^7$ and $< 3.8x10^8$ O<br>$> 1.8x10^7$ and $< 1.8x10^8$ Si<br>$> 1.1x10^6$ and $< 1.1x10^7$ Au | > 5 and < 50 rem/h | III | Barriers, Interlocked Gates, Health Physics Supervised Access |
| $> 5.8x10^9$ and $< 2.0x10^{11}$ p<br>$> 3.8x10^8$ and $< 6.8x10^9$ O<br>$> 1.8x10^8$ and $< 2.6x10^9$ Si<br>$> 1.1x10^7$ and $< 9.7x10^7$ Au | > 50 rem/h and < 500 rad/h | II | Barriers, Interlocked Gates, Access By Special Procedure |
| $> 2.0x10^{11}$ p<br>$> 6.8x10^9$ O<br>$> 2.6x10^9$ Si<br>$> 9.7x10^7$ Au | > 500 rad/h | I | Access Prohibited |

[a] Protons are 28 GeV.

[b] Oxygen and silicon ions are 13.5 GeV/nucleon.

[c] Gold ions are 11 GeV/ nucleon.

[d] The actual in-beam dose rate is 50 times higher than the 'reduced' dose rate listed in the table above. The de-rating of dose rate for small beams accounts for the fact that only a small part of the body may be directly struck by the beam, leaving most of the body intact. However, significant deterministic effects may occur along the beam path as the beam penetrates the body (see Section 5.5).